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(54) **FIBER OPTIC BASED LIGHT ORNAMENT**

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(57) **ABSTRACT**

A decorative light assembly comprises a plurality of optical fibers formed into a bundle having a length greater than one inch, the bundle having a first end for receiving light, and a second end that is fused for providing the received light as decorative illumination. The decorative light assembly is for use on, e.g., Christmas trees, windows, doors, etc.

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(21) Appl. No.: **10/269,821**

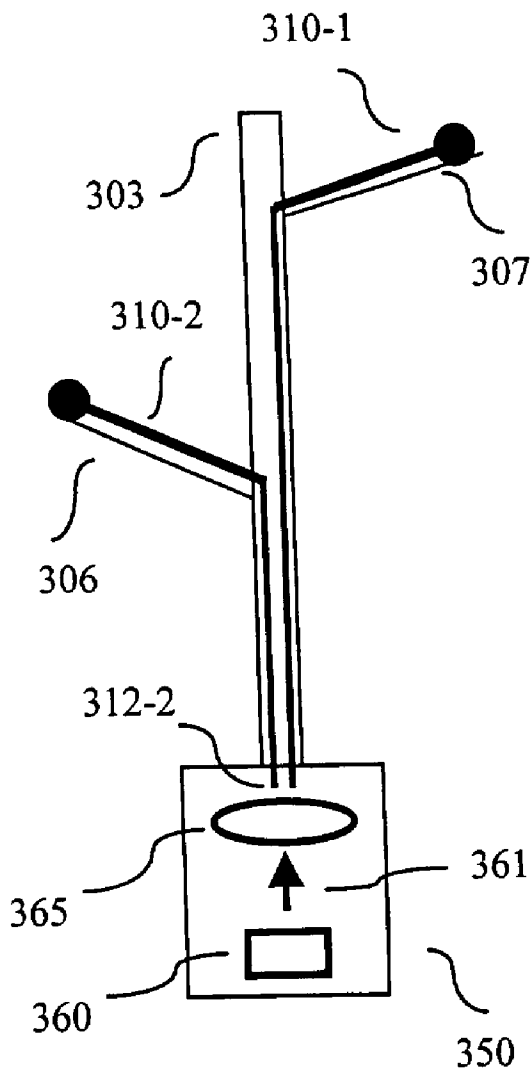


FIG. 1

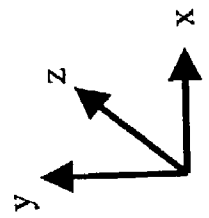
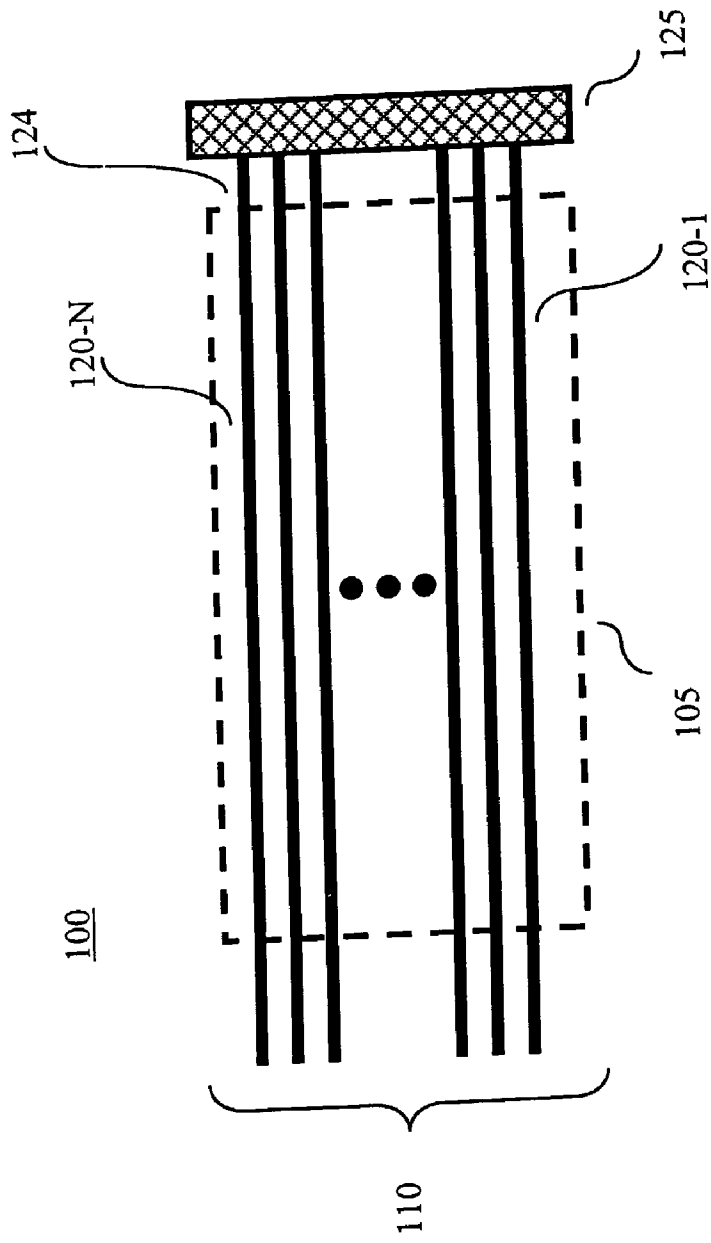


FIG. 2

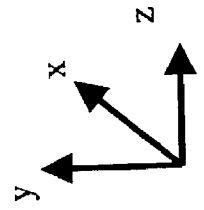
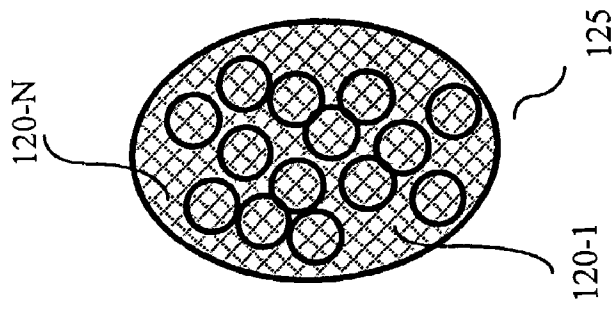


FIG. 3

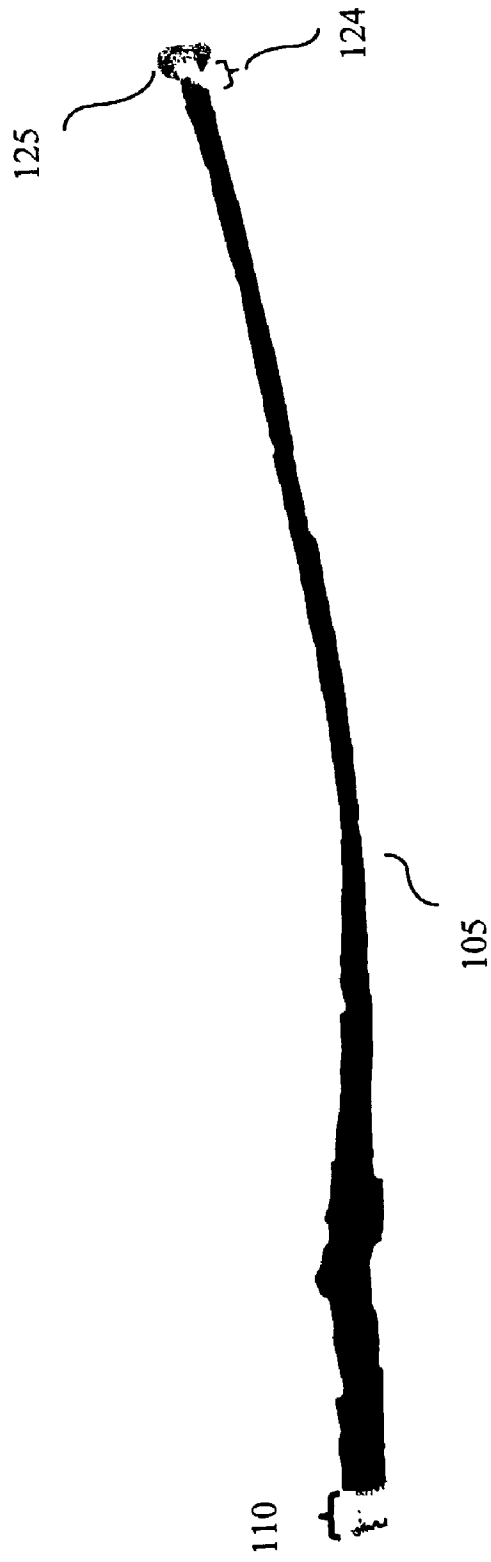
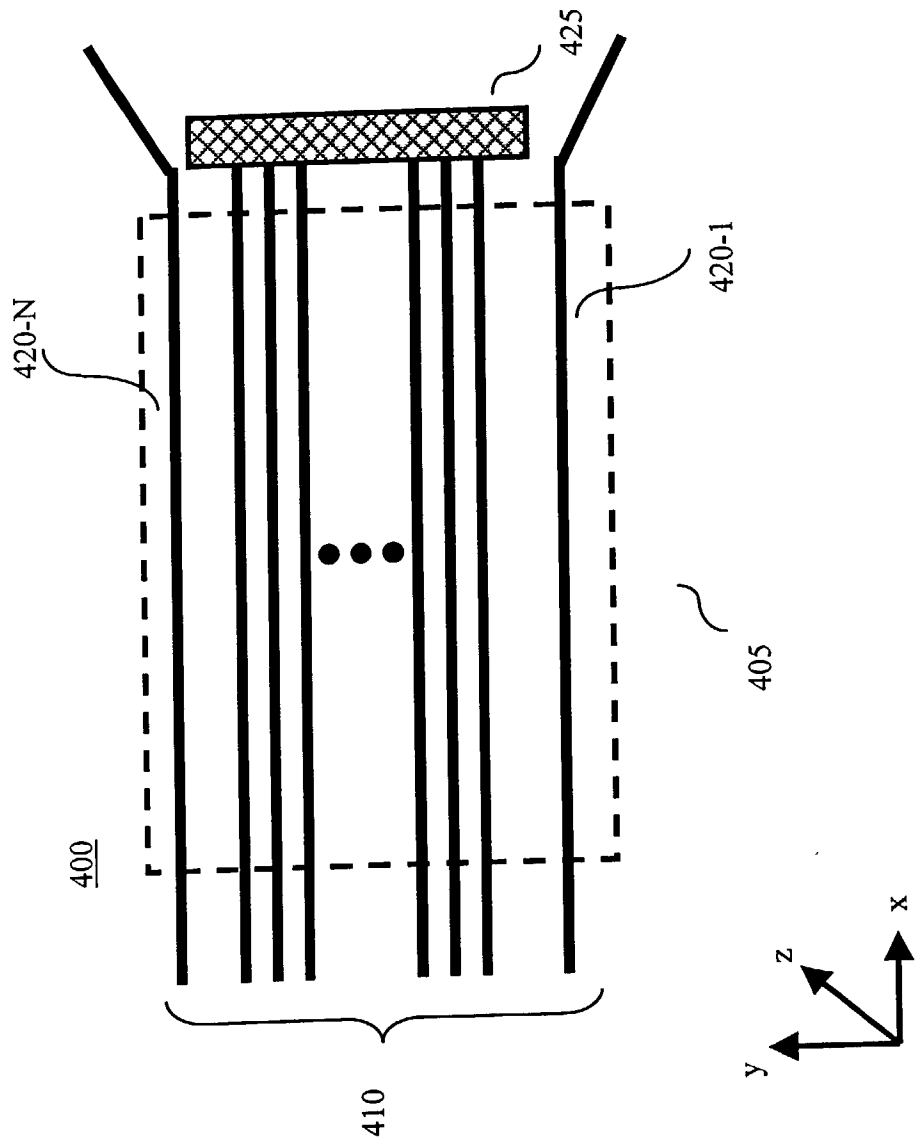


FIG. 4



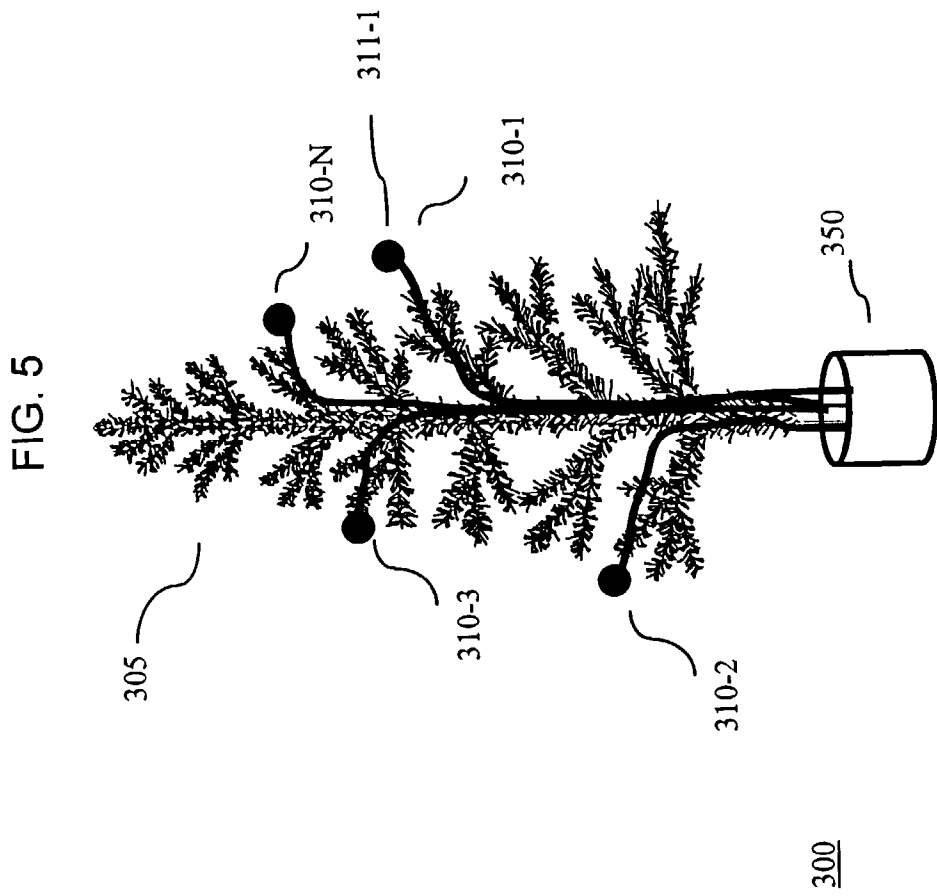


FIG. 6

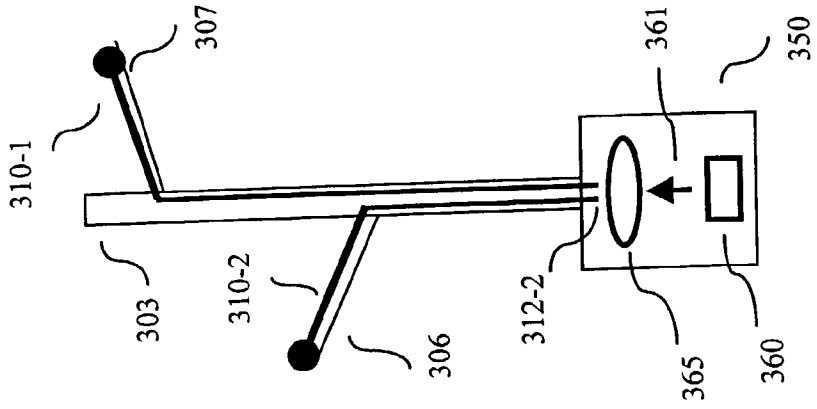


FIG. 7

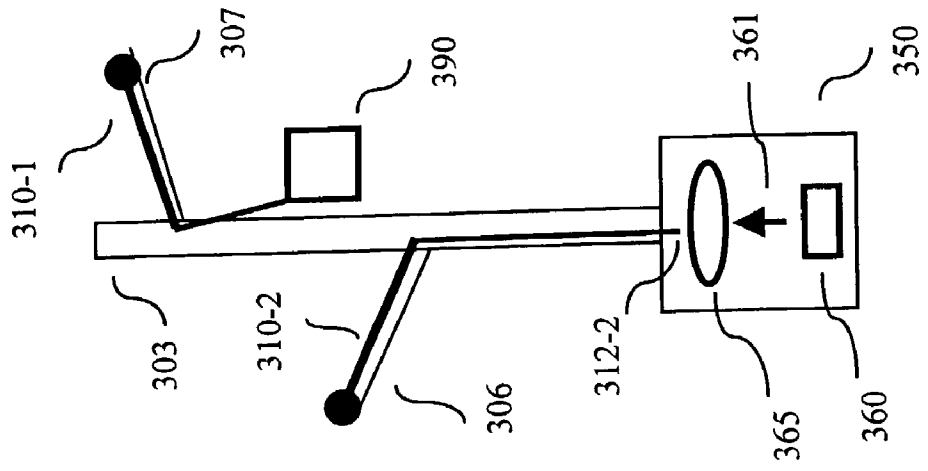


FIG. 8

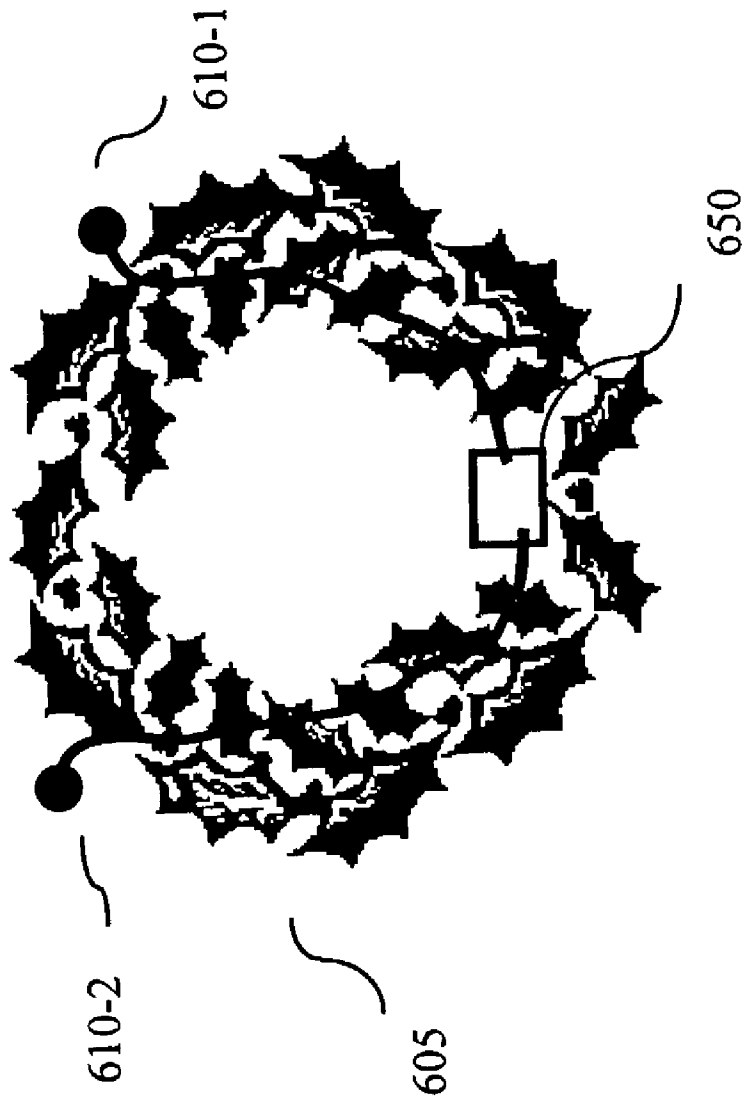


FIG. 9

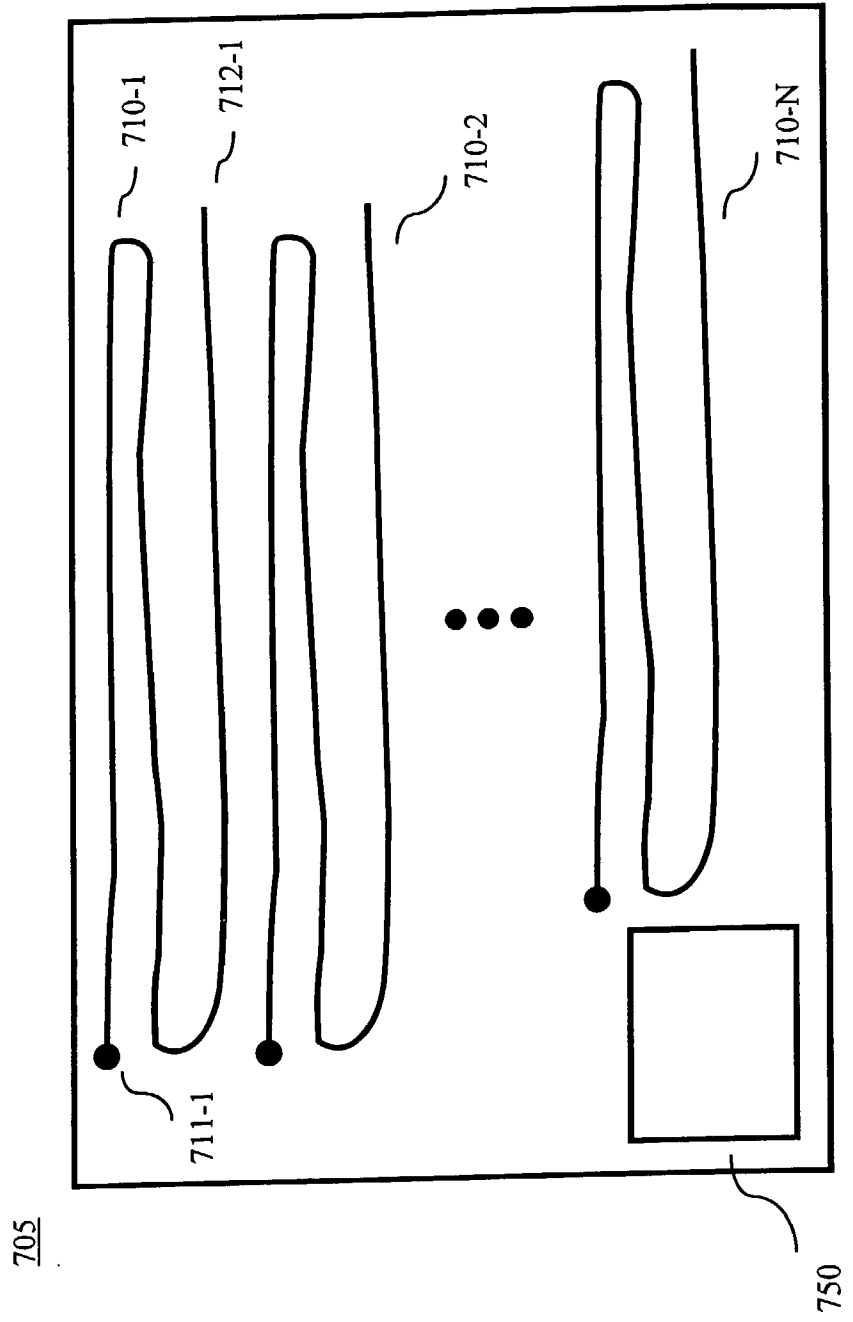


FIG. 10

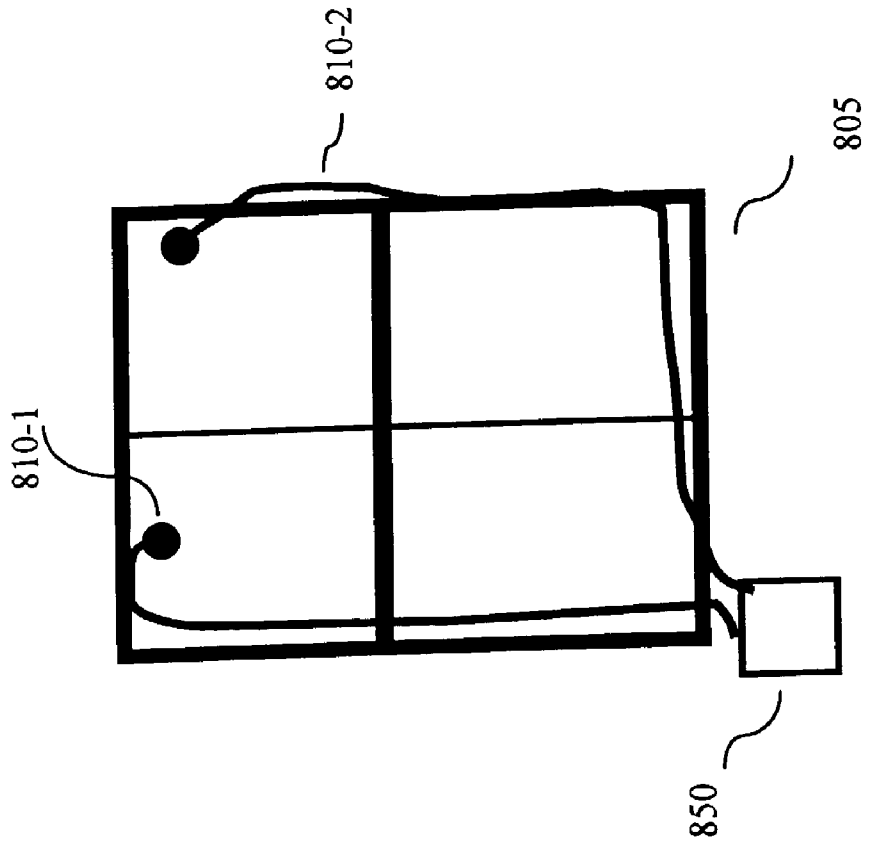


FIG. 11

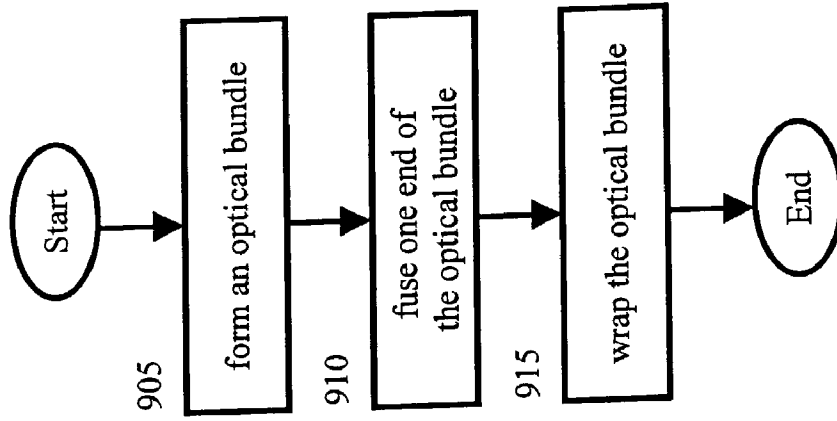


FIG. 12

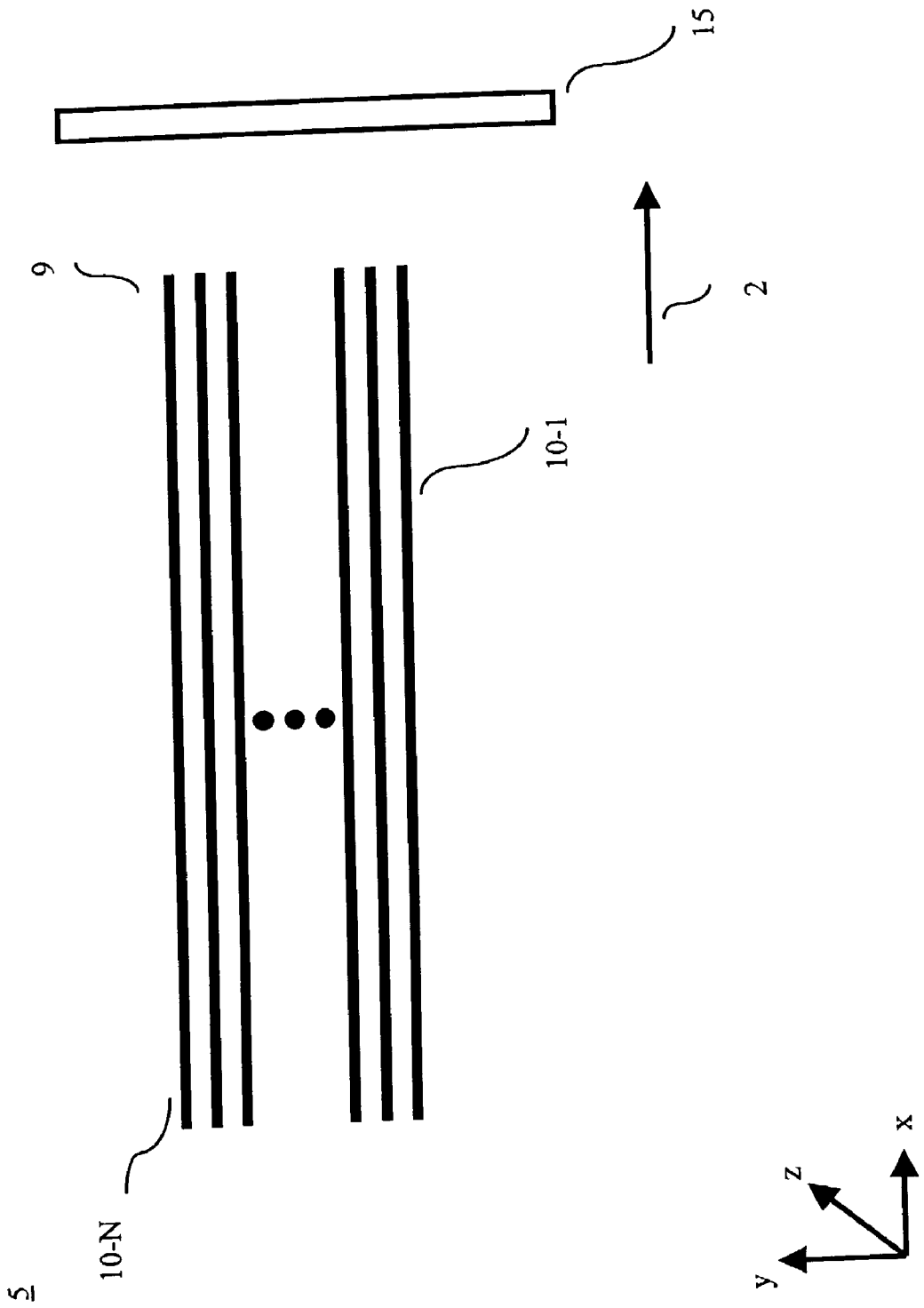
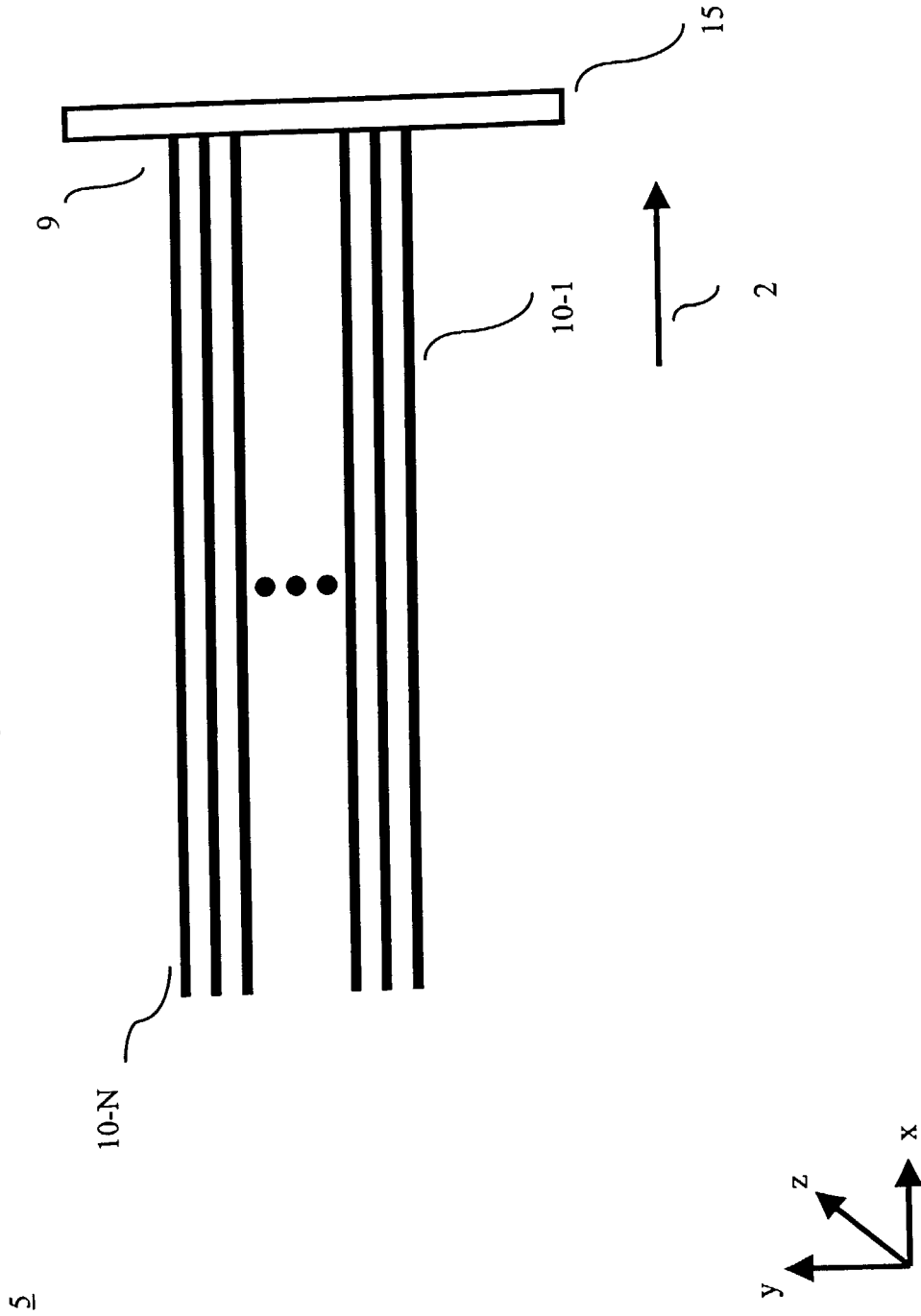


FIG. 13



5

FIG. 14

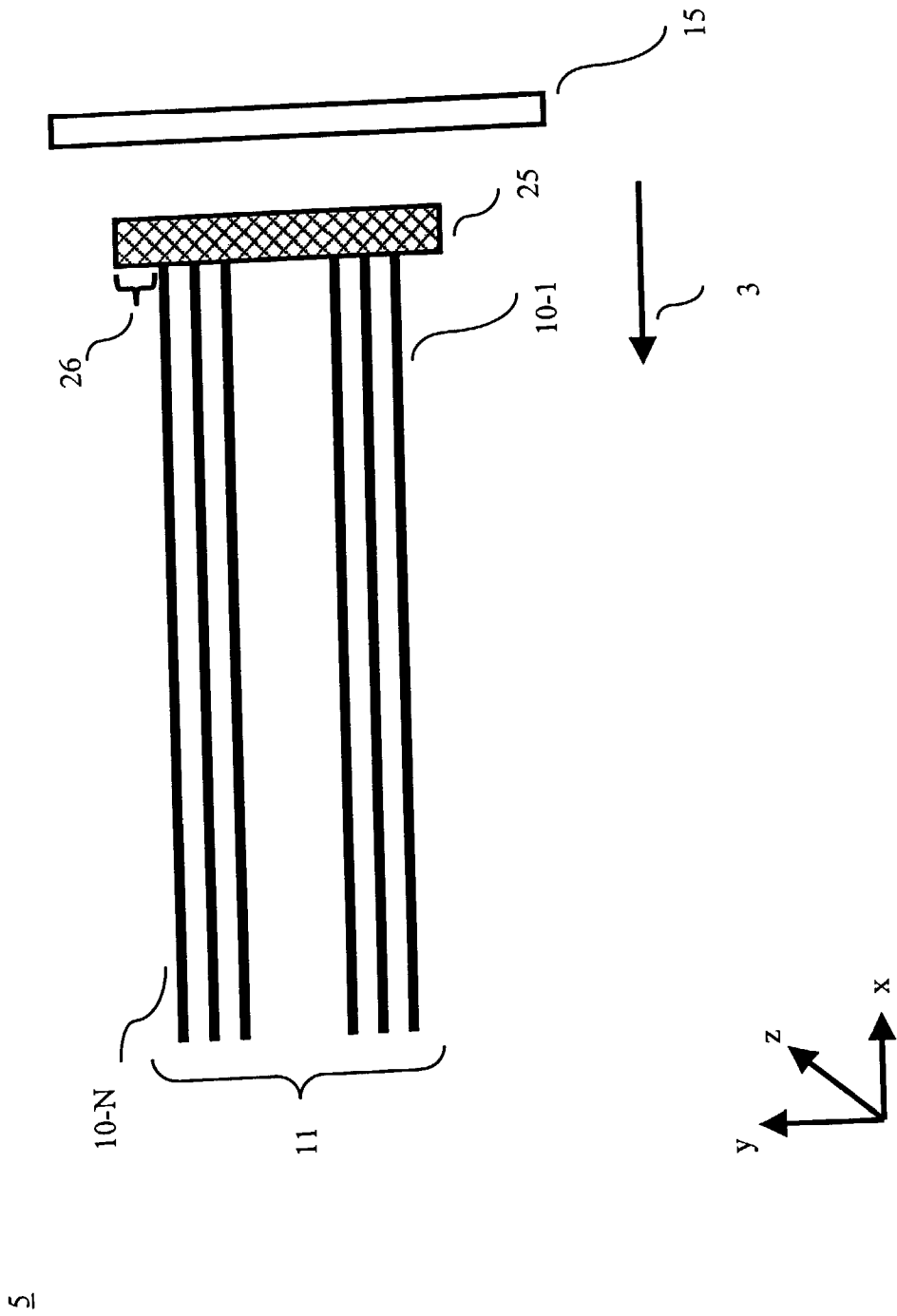


FIG. 15

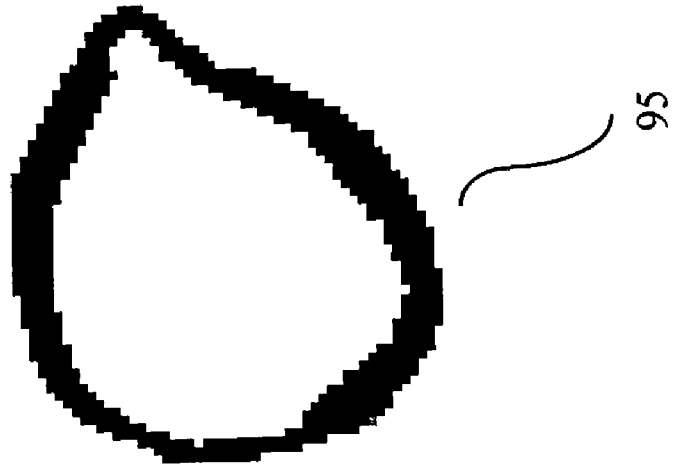
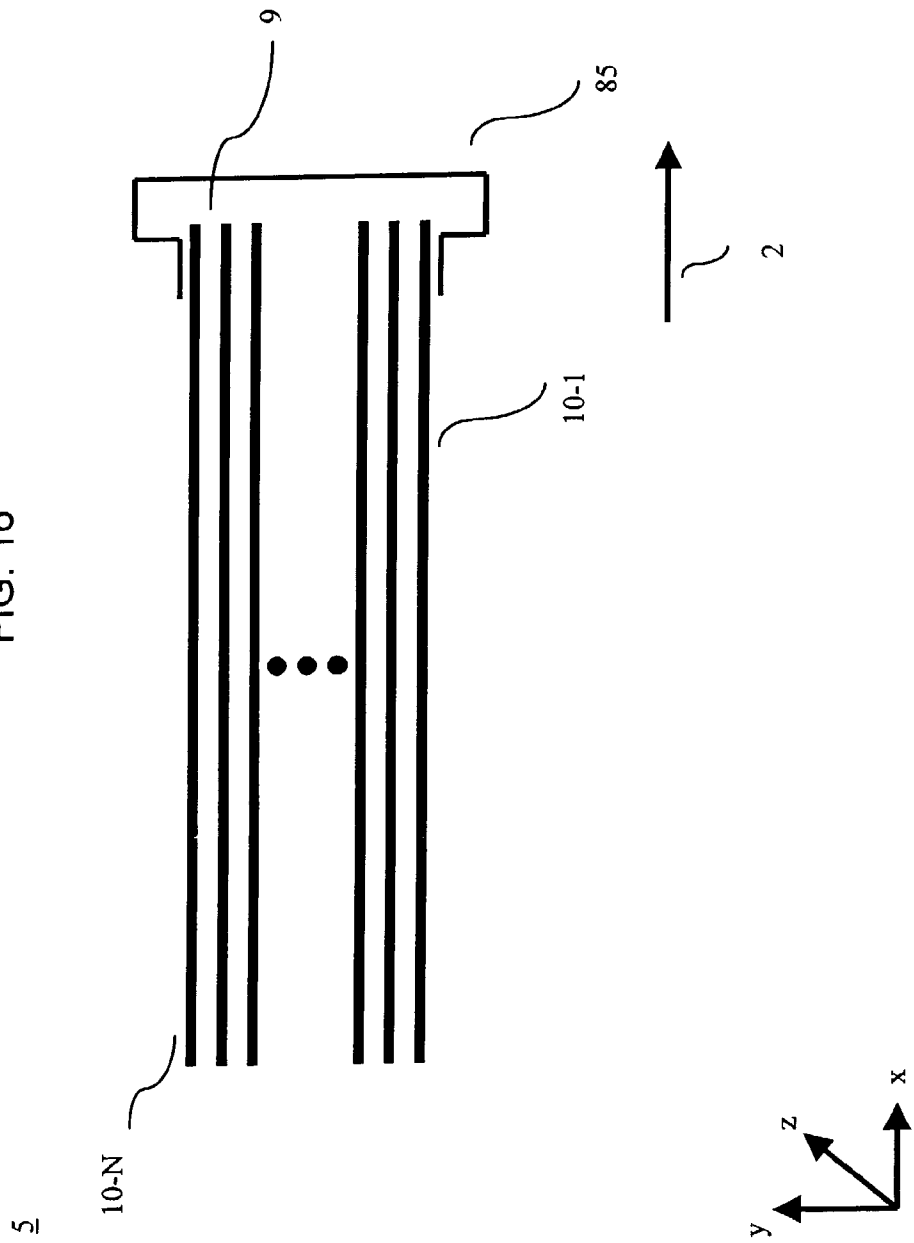


FIG. 16



FIBER OPTIC BASED LIGHT ORNAMENT

BACKGROUND OF THE INVENTION

[0001] The invention relates generally to decorative lights and, more particularly, to fiber optic based decorative lights or ornaments.

[0002] Fiber optic Christmas trees are well known such as the one illustrated in U.S. Pat. No. 5,422,797 issued Jun. 6, 1995 to Shattan. In a fiber optic Christmas tree, individual optical fibers, or strands, are arranged on the tree to provide illumination. A light source is, e.g., located at the base of the tree. The light source can utilize a color-wheel, of one or more colors, so that the color of the light emitted by each strand changes over time.

[0003] Unfortunately, a portion of the consumer market does not care for fiber optic trees for the simple reason that they "lack light." In other words, the intensity of the light output from each of the strands of optical fiber is dimmer in comparison to a more conventional Christmas tree utilizing electric light bulbs for illumination.

[0004] However, electric light sets for use as decorative items on, e.g., a Christmas tree, are not without their own problems. For example, although one can typically change their blinking frequency—one cannot change the overall color pattern once the electric lights are on the Christmas tree. In addition, and of even more concern, is their reliability—an electric bulb may fail. Indeed, depending on the design of the light set, a single electric bulb failure may cause a number of other bulbs to stop working. In this case, repair is somewhat problematic as one must first locate the failed bulb, which can be time-consuming. In addition, if a failure occurs while the light set is on the Christmas tree—intermixed with garland and other ornaments—it may be very inconvenient and difficult to repair. As a result of the reliability issue, common sense dictates that a string of bulbs be tested beforehand—again a labor and time-consuming effort. Regardless, spending the time to test an electric bulb set before placement on the Christmas tree does not ensure a bulb will not fail once arranged on the Christmas tree.

[0005] In view of the above, further improvements in decorative lighting arrangements would be desirable.

SUMMARY OF THE INVENTION

[0006] One aspect of the invention provides a decorative light assembly comprising a plurality of optical fibers formed into a bundle having a length greater than one inch, the bundle having a first end for receiving light, and a second end that is fused for providing the received light as decorative illumination. The fusing of the individual optical fibers at the second end of the bundle results in a mixing, or combining, of the light from each of the individual strands. Thus, the overall illumination from the fused end is brighter than the light from an individual strand and is comparable, if not better than, the illumination from an electric light bulb. In addition, the reliability of such a decorative light assembly is better than that of an electric light bulb since there is no bulb to fail.

[0007] In an embodiment of the invention, an ornament such as a Christmas tree is decorated with a number of optical bundles, each optical bundle having a fused end and an un-fused end. The Christmas tree includes a light source

for coupling light into the un-fused end. Illumination, or decorative lighting, of the Christmas tree is provided by the light emitted from the fused ends of the optical bundles.

[0008] In other embodiments of the invention, other ornaments, objects or items, are decorated with optical bundles having a fused end and an un-fused end such as, but not limited to, a wreaths, flowers, windows, doors, etc.

[0009] In another embodiment of the invention, a decorative light set for providing decorative lighting comprises a light source and number of optical bundles for coupling to the light source and wherein each optical bundle has a fused end.

[0010] In another embodiment of the invention, a method of manufacturing an optical bundle comprises the steps of collecting a plurality of optical fibers together to form an optical bundle; and heating at least one end of the optical bundle to fuse, or weld, the individual strands together.

[0011] In another aspect of the invention, the fused end of the optical bundle is formed into a shape. For example, one shape resembles an electric light bulb.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] **FIGS. 1 and 2** show an illustrative embodiment of a decorative light assembly in accordance with the principles of the invention;

[0013] **FIG. 3** shows an illustrative optical bundle in accordance with the principles of the invention;

[0014] **FIG. 4** shows another illustrative embodiment of a decorative light assembly in accordance with the principles of the invention;

[0015] **FIGS. 5-7** show illustrative Christmas trees in accordance with the principles of the invention;

[0016] **FIG. 8** shows an illustrative wreath in accordance with the principles of the invention;

[0017] **FIG. 9** shows an illustrative light set in accordance with the principles of the invention;

[0018] **FIG. 10** shows an illustrative window in accordance with the principles of the invention;

[0019] **FIGS. 11-14** show an illustrative process for manufacturing a decorative light assembly in accordance with the principles of the invention;

[0020] **FIG. 15** shows an illustrative shape for use in manufacturing a decorative light assembly in accordance with the principles of the invention; and

[0021] **FIG. 16** shows another embodiment of a decorative light assembly in accordance with the principles of the invention.

DETAILED DESCRIPTION

[0022] **FIG. 1** shows a side view of a decorative light assembly in accordance with the principles of the invention. It should be noted that the illustrations shown in the **FIGS.** are not to scale and some illustrations, such as **FIG. 1**, have been exaggerated for purposes of description. In addition, other than the inventive concept, the elements shown in the

figures are well known and will not be described in detail herein. Like numbers in each of the figures represent similar elements.

[0023] Optical bundle **100** comprises a number of optical fibers, or strands, **120-1** through **120-N**. Each strand is represented by a thick black line. As known in the art, a strand comprises a cladding material (not shown) surrounding a core material (not show), which provides the medium for light propagation. In accordance with the inventive concept, any type, size, and composition of optical fiber may be used. In fact, different types of optical fibers may be used in the same optical bundle. For the purposes of this example, the number of optical fibers in an optical bundle may be in the range of 12 to 15, each strand on the order of 4 to 7 mils (thousandths of an inch) in thickness. It should be noted that the inventive concept is not so limited. For example, any number of optical fibers, $N \geq 2$, may be used and the thickness of an optical fiber can be less than 4 mils or greater than 7 mils. Indeed, some or all of the optical fibers in a bundle may even differ in thickness. Surrounding these strands is a covering, or sheath **105**, represented by a dashed line. Sheath **105** can be, e.g., a colored tape, or paper wrapping. The color of sheath **105** may be selected to match the surroundings so as to hide, to an extent, the presence of optical bundle **100**. For example, if optical bundle **100** is to be arranged on a green-colored Christmas tree, the color of sheath **105** may be green to match that of the tree. It should be noted that **FIG. 1** is a two-dimensional representation of optical bundle **100** in an x-y plane. While optical bundle **100** may be in the form of a ribbon and the strands arranged in just the x-y plane, a preferred embodiment arranges the strands of optical bundle **100** in three dimensions, e.g., along the z-axis shown in **FIG. 1**.

[0024] As illustrated in **FIG. 1**, optical bundle **100** has two ends—strand end **110** and fused end **125**. Strand end **110** comprises the individual optical fibers and illustratively extends beyond sheath **105**. Strand end **110** is coupled to a light source (not shown). At the opposite end of optical bundle **100** is fused end **125**. In fused end **125** each of the strands **120-1** to **120-N** are, in accordance with the principles of the invention, fused, or melted together. This “fusing” of each of the strands is represented by the crosshatched area of fused end **125**. The fusing of the individual optical fibers at the second end of optical bundle **100** results in a mixing, or combining, of the light from each of the individual strands. That is, the creation of a light combining region. Thus, the overall illumination from fused end **125** is brighter than the light from an individual strand (such as strand **120-1**) and is comparable, if not better than, the illumination from an electric light bulb (not shown). In fact, the white light available from an optical bundle may be crisper, i.e., appear “whiter” than the white light available from a conventional electric bulb. In addition, the reliability of such a decorative light assembly is better than that of an electric light bulb since there is no bulb to fail. As shown in **FIG. 1**, there may be a gap **124** between the fused end **125** and sheath **105**.

[0025] Turning now to **FIG. 2**, a front view of optical bundle **100** is shown. As illustrated in **FIG. 2**, optical bundle **100** extends in the z-axis and the strands **120-1** to **120-N** are fused together. As can be observed from **FIG. 2**, optical bundle **100** comprises 14 strands (i.e., $N=14$). However, any number of fibers may be used in an optical bundle. Indeed,

the amount of illumination from an optical bundle can be varied by having more or less strands, thinner or thicker strands, and/or combinations thereof.

[0026] An actual black and white image of an illustrative optical bundle in accordance with the principles of the invention is shown in **FIG. 3**.

[0027] Another illustrative embodiment is shown in **FIG. 4**. Optical bundle **400** is similar to optical bundle **100** of **FIG. 1** except that one or more optical fibers are not a part of fused end **425**. In this example, two fibers, **420-1** and **420-N**, are not included in the plurality of optical fibers having fused end **425**. It should be noted that it is not required that these single strands emit any light and may be merely for decoration around fused end **425**.

[0028] Another illustrative embodiment is shown in **FIG. 5**. A Christmas tree **300** comprises a tree portion **305** supported by a light box **350**. The latter serves as a light source and may include a color wheel comprising one, or more, colors. In accordance with one aspect of the invention, arranged on tree **300** are a number of optical bundles, N , as represented by optical bundles **310-1**, **310-2**, **310-3** and **310-N**. Each optical bundle has a fused end, as represented by the enlarged ball shape (e.g., **311-1**), and an un-fused end (not shown) disposed in light box **350**. It should be noted that other ornaments, and even other light ornaments (e.g., electric bulbs, single strand fibers) may also be decorated on tree **300**. The light source (not shown) of light box **350** provides light to the un-fused end of each optical bundle. The light is guided by each strand of an optical bundle towards the fused end. Upon reaching the fused end, the light from each strand combines to provide a level of illumination comparable to, if not brighter than, an electric bulb.

[0029] **FIG. 6** illustrates another view of Christmas tree **300**. The latter comprises a center post or metal pole **303**, around which each optical bundle (as represented by optical bundles **310-1** and **310-2**) is placed, weaved or wrapped. It should be noted that the optical bundles themselves may be further covered, or wrapped, to hide the presence of the optical bundles in the tree. The illustrative optical bundles of **FIG. 6** are arranged along branches **306** and **307**. Along each branch an optical bundle may be wrapped or attached via a clip (not shown). However, the arrangement of the optical bundles on the tree can be in any fashion. As illustrated in **FIG. 6**, the un-fused ends of each optical bundle, e.g., un-fused end **312-2**, are disposed in light box **350**. The latter comprises a light source **360** (e.g., a bulb), a power source (not shown) and, optionally, a color wheel **365**. Light from light source **360** is emitted generally along the direction of arrow **361** to pass through color wheel **365** and then enter the un-fused end of the N optical bundles as represented by un-fused end **312-2**. The light is guided by each strand of an optical bundle towards the fused end, as described above.

[0030] As noted above, any number of optical bundles may decorate a tree. The number will depend on the height of the tree and the intended decorative affect. For example, a tree with a height 8 feet may have on the order of 400 to 500 optical bundles as decoration. It can also have as few as one optical bundle. It should also be noted that a tree can come in one or more sections for ease of assembly. In addition, it can easily be observed from **FIGS. 5** and **6** that

optical bundles will come in different lengths. For example optical bundle **310-2** is shorter than optical bundle **310-1**. Consequently, optical bundle **310-1** will attenuate the light more than optical bundle **310-2**. This attenuation may become more noticeable in a taller tree (e.g., an 8 foot tree). As such, in taller trees it may be preferable to have multiple light boxes to compensate for this optical attenuation. For example, a bottom light box as illustrated in **FIGS. 5 and 6** for providing light to optical bundles on, e.g., the lower half of the tree, and another light box arranged towards the top of the tree for providing light to the remaining optical bundles. This is illustrated in **FIG. 7** where the length of optical bundle **310-1** has been shorted by coupling to light box **390** instead of light box **350**. Light box **390** may be coupled to the tree in any fashion.

[0031] Another embodiment in accordance with the principles of the invention is shown in **FIG. 8**. A wreath, or garland, **605** is decorated with one or more optical bundles, as represented by optical bundles **610-1** and **610-2**, which are coupled to a light source **650**.

[0032] In accordance with another aspect of the invention, attention should be turned to **FIG. 9**, which illustrates another embodiment. A light set package **705** comprises a number of optical bundles, **710-1**, **720-2** and **710-N**. Each optical bundle has a fused end (e.g., fused end **711-1** of optical bundle **710-1**) and an un-fused end (e.g., un-fused end **712-1** of optical bundle **710-1**). Light set package **705** also includes a light source **750** for coupling to the un-fused ends of the optical bundles. Light source **750** is similar to the light box described above and includes, e.g., a bulb, optional color wheel and a power source (or means for coupling thereto). The optical bundles of light set package **705** may be of differing lengths.

[0033] Such a light set package can be used to decorate not only trees and wreaths but also other items. An illustrative embodiment of which is shown in **FIG. 10**. In **FIG. 10**, a window **805** is decorated with one, or more, optical bundles as represented by optical bundles **810-1** and **810-2**. The un-fused ends of the optical bundles are coupled to light source **850**. The latter is similar to the light box described above and includes, e.g., a bulb, optional color wheel and a power source (or means for coupling thereto).

[0034] An illustrative process for manufacturing an optical bundle in accordance with the principles of the invention is shown in **FIG. 11**. In step **905** a plurality of optical fibers or strands of approximately the same length are collected together to form a bundle. In step **910**, at least one end of the optical bundle is fused together. In step **915**, the optical bundle is wrapped. It should be noted that the optical bundle may be wrapped, e.g., in a sheath, before fusing. However, in such a case care should be taken with respect to that portion of the wrapping that is in close proximity to—what will be—the fused end of the optical bundle due to heat from the fusing, or melting, process.

[0035] **FIGS. 12-14** further illustrates step **910** of **FIG. 11**. Turning first to **FIG. 12**, as a result of step **905** of **FIG. 11**, an optical bundle **5** comprises a plurality of optical fibers, or strands, **10-1** to **10-N**. Optical bundle **5** is moved in the direction of arrow **2** towards a hot plate **15** (e.g., a steel plate heated to a temperature suitable to fuse, or melt, the fibers). Turning now to **FIG. 13**, end **9** of optical bundle **5** is pressed against hot plate **15**—thus melting or fusing that end of

optical bundle **5**. As shown in **FIG. 14**, after, e.g., $\frac{1}{16}$ of an inch of the optical bundle has been fused, optical bundle **5** is removed from contacting the surface of hot plate **15**. The resulting fused portion of optical bundle **5**—fused end **25**—may have a larger nominal size cross-section than the nominal size cross-section of the remainder of optical bundle **5**. This is illustrated in **FIG. 14** by the existence of flared portion **26** of fused end **25**. Illustratively, the flared portion **26** is on the order of $\frac{1}{16}$ of an inch. This flared portion may be removed, e.g., cut-off, or may be left as is to ease the manufacturing process. Indeed, the flared portion can also be increased in size (by continued melting of that end of the bundle).

[0036] In another aspect of the invention, the fused end of the optical bundle is formed into a shape by, e.g., placing end **9** of optical bundle **5** of **FIGS. 12-14** into a mold (not shown), which is then heated to fuse the strands therein into the particular shape. As end **9** of optical bundle **5** melts, optical bundle **5** is pressed into the mold until the mold is filled with melted material, at which point the process is terminated. Illustrative shapes may include, e.g., the shape of an electric light bulb as illustrated in **FIG. 15** by mold **95**. It should be noted that other methods of shaping the end may be used such as, but not limited to, filing, abrasion, etc.

[0037] Another embodiment of the invention is shown in **FIG. 16**. In this embodiment, a light combining region is formed—not by fusing or melting the individual strands—but by placement of the individual strands of end **9** of optical bundle **5** into a shaped cover **85**, e.g., a bulb shell (e.g., the form of a bulb) or lens.

[0038] Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. For example, the optical bundles may also decorate other ornaments or items, e.g., doors, doorways etc., etc. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as defined by the appended claims.

1. A decorative light assembly comprising:

a plurality of optical fibers formed into a bundle, the bundle having a first end for receiving light, a second end for providing the received light as decorative illumination and a length greater than one inch; and

a light combining region for combining the received light in each of the plurality of optical fibers;

wherein the light combining region is formed from a portion of the bundle located at the second end.

2. The assembly of claim 1 further comprising at least one single strand of optical fiber that is not a part of the light combining region.

3. The assembly of claim 1, wherein the light combining region has a nominal size cross-section greater than a nominal size cross-section of the first end of the bundle.

4. The assembly of claim 1, wherein the light combining region includes a lens for receiving the second end.

5. The assembly of claim 1, wherein the light combining region includes a shaped cover for receiving the second end.

6. A decorative light assembly comprising:
- a plurality of optical fibers formed into a bundle, the bundle having a first end for receiving light, a second end for providing the received light as decorative illumination and a length greater than one inch;
- wherein the first end includes un-fused ends of the plurality of optical fibers and the second end includes fused ends of the plurality of optical fibers for combining the received light.
7. The assembly of claim 6 further comprising at least one single strand of optical fiber having a second end that is not fused.
8. The assembly of claim 6, wherein the fused ends have a nominal size cross-section greater than a nominal size cross-section of the first end of the bundle.
9. A light set package for use in decorating an object, the light set package comprising:
- a plurality of optical fiber bundles, each bundle comprising at least N optical fibers, where $N > 1$, each bundle having a first end for receiving light, a second end for providing the received light as decorative illumination and a length greater than one inch; and
 - a light source for providing light to the first end of at least one of the bundles;
- wherein each optical fiber bundle includes a light combining region located at the second end for combining the received light from the at least N optical fibers of the bundle.
10. The package of claim 9 wherein the second end is fused to form the light combining region.
11. The package of claim 9 wherein at least one of the optical fiber bundles includes at least a single strand of optical fiber that is not a part of the light combining region.
12. The package of claim 9, wherein the light combining region has a nominal size cross-section greater than a nominal size cross-section of the first end of the bundle.
13. The package of claim 9, wherein the light combining region includes a lens for receiving the second end.
14. The package of claim 9, wherein the light combining region includes a shaped cover for receiving the second end.
15. Apparatus comprising:
- at least one bundle of optical fibers, the bundle having a first end for receiving light, a second end for providing the received light as decorative illumination and a length greater than one inch; and
 - a light source for providing light to the first end;
- wherein the bundle includes a light combining region located at the second end for combining the received light from each of the optical fibers.
16. The apparatus of claim 15, wherein the light combining region has a nominal size cross-section greater than a nominal size cross-section of the first end of the bundle.
17. The apparatus of claim 15 wherein at least one of the optical fiber bundles includes at least a single strand of optical fiber that is not a part of the light combining region.
18. The apparatus of claim 15 further comprising a Christmas tree decorated with the at least one bundle of optical fibers.
19. The apparatus of claim 15 further comprising a Christmas tree decorated with a plurality of bundles of optical fibers.
20. The apparatus of claim 15 further comprising a wreath decorated with the at least one bundle of optical fibers.
21. The apparatus of claim 15 further comprising a wreath decorated with a plurality of bundles of optical fibers.
22. The apparatus of claim 15, wherein the light combining region includes a lens for receiving the second end.
23. The apparatus of claim 15, wherein the light combining region includes a shaped cover for receiving the second end.
24. Apparatus comprising:
- at least one bundle of optical fibers, the bundle having a first end for receiving light, a second end for providing the received light as decorative illumination and a length greater than one inch; and
 - a light source for providing light to the first end;
- wherein the bundle includes a light combining region located at the second end and wherein the light combining region is formed by fusing the optical fibers together at the second end.
25. The apparatus of claim 24, wherein the light combining region has a nominal size cross-section greater than a nominal size cross-section of the first end of the bundle.
26. The apparatus of claim 24 wherein at least one of the optical fiber bundles includes at least a single strand of optical fiber that is not a part of the light combining region.
27. The apparatus of claim 24 further comprising a Christmas tree decorated with the at least one bundle of optical fibers.
28. The apparatus of claim 24 further comprising a Christmas tree decorated with a plurality of bundles of optical fibers.
29. The apparatus of claim 24 further comprising a wreath decorated with the at least one bundle of optical fibers.
30. The apparatus of claim 24 further comprising a wreath decorated with a plurality of bundles of optical fibers.
31. A method for manufacturing a decorative light assembly, the method comprising the steps of:
- forming a plurality of optical fibers into a bundle, the bundle having a length greater than one inch, a first end and a second end; and
 - heating a portion of the second end of the bundle to at least a temperature that causes the second end to become fused together to form a light combining region.
32. A method for manufacturing a decorative light assembly, the method comprising the steps of:
- forming a plurality of optical fibers into a bundle, the bundle having a length greater than one inch, a first end and a second end; and
 - forming a light combining region at the second end of the bundle.
33. The method of claim 32 wherein the forming step includes the step of heating a portion of the second end of the bundle to at least a temperature that causes the second

end to become fused together to form a light combining region.

34. The method of claim 32 wherein the forming step includes the step of placing the second end of the bundle into a lens.

35. The method of claim 32 wherein the forming step includes the step of placing the second end of the bundle into a bulb shell.

* * * * *